

Some aspects of Bio-Ecology of
Podagrica orbiculata (Motsch.)
(Coleoptera: Chrysomelidae) as a
pest of *Abelmoschus esculentus*
at Sehore (M.P.)

BY

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(With two text-figures)

Podagrica orbiculata (Motsch.) *bowringi* (Baly.) appeared as a serious pest of young plants of Lady's finger (*Abelmoschus esculentus*) during 1960 from July onwards in and around Sehore (M.P.). This is the first record of the occurrence of the pest and economic damage thereof in Madhya Pradesh. There is no published work on this pest except some occasional records of its occurrence in some parts of India. Maulik (1926) included it in his key to the spp. of the genus *Podagrica* in the FAUNA OF BRITISH INDIA on Chrysomelidae. Ayyar (1940) mentioned it as an occasional minor pest of 'bhindi' in south India. Chowdhary (1962) recorded it as a major pest of *Hibiscus cannabinus* in Tripura, the adults appearing in large numbers after rain in July 1956 and feeding on the leaves in abundance. Many other species of *Podagrica* have been reported from other countries as major pests, mostly on malvaceous plants, like *P. puncticollis* Weise. and *P. pallida* Jac. on cotton and *Hibiscus* spp. in Sudan (Pollard 1955; Schmutterer 1962), *P. breweri* Baly. on cotton seedlings in Queensland (Sloan 1937), *P. malvae* Illig. on cotton in Russia (Vasilev 1924), *P. ceylonensis* Jac. on *Hibiscus rosasinensis* in Ceylon (Hutson 1939) etc. In view of the serious infestation of *P. orbiculata* (Motsch.) on 'bhindi' and the scanty published work on it, some aspects of its bio-ecology were studied at Sehore, the findings are reported in this paper.

MATERIALS AND METHODS

Mass collections of the adult beetles were made from the College Farm and other fields. The beetles were confined in glass bell jars with

the open top tied with muslin cloth, and containing moist soil in large petridishes. Fresh tender 'bhindi' leaves were provided as food regularly. The beetles oviposited readily in moist soil. The eggs were removed from the soil under a binocular microscope with fine soft wet brush and counted daily.

For determining the incubation period the eggs were kept on moist blotting paper in petridishes. Effect of moisture on extent of oviposition was studied by providing a choice of wet, moist and air-dry soils in small petridishes to the ovipositing beetles and the number of eggs laid in each type of soil was recorded daily. Effect of moisture on the survival and viability of eggs was studied by keeping the freshly laid eggs on dry and wet blotting papers in petridishes.

Incidence of the pest was recorded on the basis of percentage of plants infested and number of beetles per plant every fourth day from the beginning of the activity of the pest and was correlated with the meteorological data.

OBSERVATIONS AND DISCUSSION

Mating : Mating occurs frequently both during day and night and a male is able to fertilize a number of females. Mating pairs are very commonly seen in the field. Mating period, as observed in seven cases, ranged from 7 to 15 minutes with an average of 10.7 minutes.

Oviposition : Eggs are usually laid in loose moist soil either singly or in small groups each of 2 to 6 eggs near the base of host plants at a depth of about 0.3". Similar observations have been made in case of other species of *Podagrica* by Manolache, Dobreanu & Manolache (1938, 1943). Rate of oviposition of field collected beetles was found to decline progressively from July to September (Table 1).

TABLE I

OVIPOSITION RATE OF *P. orbiculata* DURING DIFFERENT PERIODS OF ITS ACTIVITY

Period	No. of beetles confined		Average no. of eggs laid per female per day
	Male	Female	
19th to 24th July	12	8	15.0 to 18.7
2nd to 8th August	11	14	5.0 to 7.5
1st to 8th September	30	20	4.0 to 5.5
19th to 27th September	30	20	0.0 to 0.3

The oviposition was thus maximum during later part of July and declined progressively to zero by the end of September when the beetles were found to contain mostly immature ovaries.

Effect of Temperature and Moisture on Oviposition: As in nature the eggs were usually found in moist soil and very few or none in wet or dry soil, a laboratory experiment was conducted to assess the effect of moisture on oviposition. The daily oviposition by the same 20 ovipositing female beetles in wet, moist and air-dry soils is given in Table 2.

TABLE 2
OVIPOSITION BY *P. orbiculata* IN AIR-DRY, MOIST AND WET SOILS

Date of observation	No. of eggs laid by 20 females			Mean Temp. in °F.	
	Total	In air-dry soil	In wet soil		In moist soil
31-viii-'60	100	Nil	25	75	85.0
1-ix-'60	83	"	18	65	84.0
2-ix-'60	105	"	20	85	84.5
3-ix-'60	101	"	10	91	84.5
4-ix-'60	114	"	25	89	89.0
5-ix-'60	80	"	30	50	90.0
6-ix-'60	95	"	40	55	90.5
7-ix-'60	100	"	60	40	91.0
8-ix-'60	80	"	30	50	89.0
9-ix-'60	84	"	30	54	87.0
10-ix-'60	70	"	25	45	87.0
11-ix-'60	55	"	15	40	87.0
12-ix-'60	55	"	20	35	84.5
Grand Total	1122	Nil	348	774	

The moisture status of the soil was found to have a profound influence on the oviposition. Out of a total of 1122 eggs, the largest number (774) were laid in moist soil, comparatively much less (348) in wet soil and nil in dry soil. There is also an indication that temperature has a modifying effect on the oviposition response in relation to soil moisture. At a relatively higher mean temperature of 90° and 90.5° the difference in the number of eggs laid in moist and wet soils was much minimised and at 91.0°F there were actually more eggs laid in wet soil than in moist soil. However, this point needs further investigation.

Egg incubation period and effect of moisture on viability: Freshly laid eggs are light yellowish, later turning to deep orange. The eggs are oval, about 0.75 to 1 mm. in length and 0.50 to 0.65 mm. in width (Fig. 1). The incubation period, in contact with free moisture ranged from 4 to 6 days (average 5.1 days) during July and 5 to 13 days (average 7.0 days) during August (Table 3).

The influence of moisture on viability of eggs was assessed by keeping the eggs simultaneously on wet blotting paper (thus providing constant contact with free moisture) and on dry blotting paper (Table 3).

TABLE 3

INCUBATION PERIOD AND PERCENTAGE VIABILITY OF EGGS OF *P. orbiculata* ON WET AND DRY BLOTTING PAPERS

Eggs kept on	Date of egg laying	No. of eggs kept	No. of eggs hatched	Egg period (in days)	Percentage hatched
Wet blotting paper	20-vii-'60	25	22	4 to 6 (average 5.1)	88.0
Wet blotting paper	28-vii-'60	100	75	5 to 13 (average 7.0)	75.0
Dry blotting paper	28-vii-'60	100	4	6 to 10 (average 7.5)	4.0

Contact with free moisture was found to increase viability up to 75 to 88% as against only 4% on dry blotting paper. Contact with free moisture also seemed to accelerate egg development to some extent.

First larval instar and total life cycle : The first instar larva (Fig. 1)

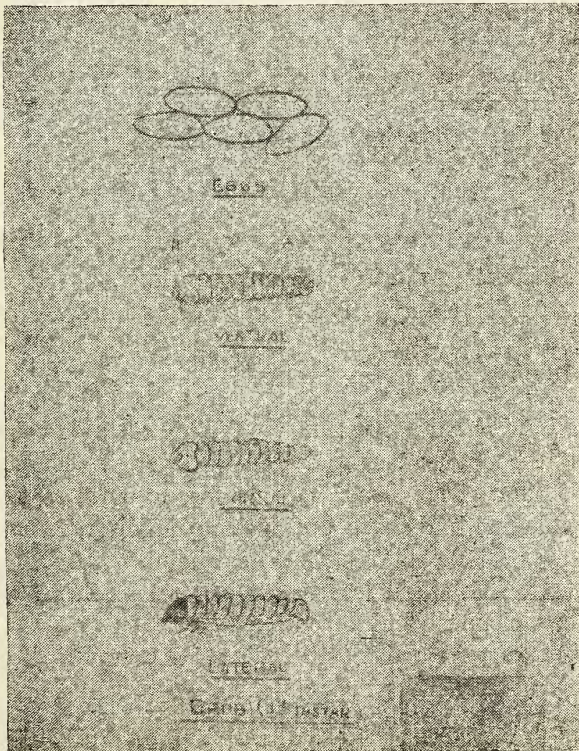


Fig. 1. Eggs and 1st instar grub of *Podagrica orbiculata* (Motsch.)

is minute, about 1 mm. in length and 0.25 mm. in width, rather sluggish and dirty yellowish-white. The head capsule is light yellowish and the mouth parts are light reddish brown. Antennae are minute papillae-like and single segmented. Thoracic legs are 5-segmented. Abdomen is devoid of legs and terminates in a dorso-ventrally flattened rounded plate. Minute setae are present all over the body and head. Those on the dorsal side of the body are smaller and clubbed but those on the head and ventral side of the body are relatively longer and tapering.

As the pest could not be reared in dishes beyond the 1st larval instar, various larval instars and pupae could not be studied. The total life-cycle could, however, be studied in a few cases by confining 10 to 15 ovipositing beetles on each of the four potted Lady's finger plants, removing them on the 2nd day and noting the date of emergence of adult beetles of the next generation (Table 4).

TABLE 4

DURATION OF TOTAL LIFE-CYCLE OF *P. orbiculata*

Pot No.	Date of egg laying	Date of emergence of beetles	No. of beetles emerged	Life-cycle (in days)	Average room temperature (in °F)
1	26-viii-'60	20-ix-'60	1	25	83.2
2	27-viii-'60	19-ix-'60	2	23	83.2
3	1-ix-'60	23-ix-'60	1	22	85.1
4	1-ix-'60	..	Nil	..	85.1

The total life cycle from egg to adult was thus 22 to 25 days during late August and September. The average egg period during this time being 5 to 7 days, the total larval plus pupal period can be said to be about 17 to 18 days.

Adult beetles, habits and sex ratio : Freshly emerged beetles are pale coloured but the colour deepens soon afterwards. The body length is about 4-5 mm. The head capsule, pronotum and antennae are reddish in colour. The elytra are black with punctuations arranged in double rows, completely covering the abdomen. The legs are also black in colour. The hind legs are longer than other legs and their femora are conspicuously thickened (Fig. 2).

The beetles are quite active and sensitive. On touching or approaching them they usually press their antennae and legs against their body and fall off or jump off the plants, and remain quiescent for sometime before commencing activity again. They are usually found on the upper surface of leaves but during noon they move to the undersurface

of leaves or under grasses and weeds growing in the field. On cloudy days the beetles remain on the upper surface of leaves throughout the day.

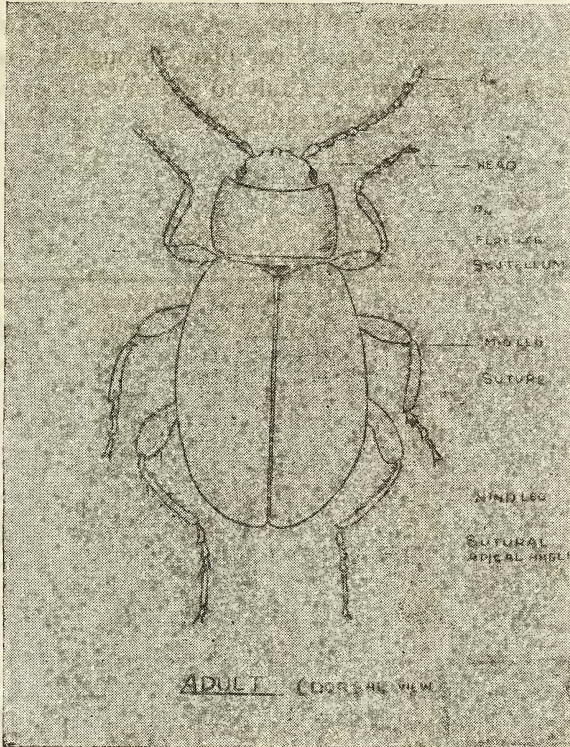


Fig. 2. Adult beetle of *Podagrica orbiculata* (Motsch.)

In the beginning (July) and end (October) of the pest activity the males slightly out-number the females but during August-September the number of females was about $1\frac{1}{2}$ times that of males. The average ratio of females to males during the whole period of seasonal activity was 53 : 47.

Nature and extent of damage : The damage is caused both by the adults which feed on the leaves as well as the larvae which feed on the roots, but chiefly by the adults. Young tender leaves are more subject to attack but in severe infestation all the leaves are damaged. The beetles cut small holes in leaf blades and in case of heavy damage completely skeletonize them. Most severe damage is caused to seedlings having 2 to 4 leaves. Similar damage by adult beetles and larvae has been reported in other species of *Podagrica* by Manolache, Dobreanu & Manolache (1938, 1943). As a result, plant growth is considerably

hindered, fruit setting is delayed and the fruits formed are undersized and less in number. When the beetles feed on the terminal shoots, young leaf buds are destroyed, which checks the apical growth.

Seasonal abundance : The seasonal incidence of the pest was noted by recording the percentage of plants on which beetles were present and the average number of beetles per plant throughout the period of activity of the pest from middle of July to end of October on every 4th day and was correlated with prevailing weather conditions (Table 5).

TABLE 5
SEASONAL INCIDENCE OF *P. orbiculata* WITH PREVAILING TEMPERATURE
AND RELATIVE HUMIDITY

Date of observation	% of plants infested	Average no. of beetles per plant	Average temp. (in °F)	Average percentage R.H.
17-vii-'60	100	4.6	82.3	75.6
21-vii-'60	100	4.0	85.7	76.6
25-vii-'60	100	5.5	80.7	84.8
29-vii-'60	100	5.6	77.5	88.5
2-viii-'60	100	6.5	75.6	91.5
6-viii-'60	100	8.3	75.5	94.0
10-viii-'60	100	8.6	73.6	91.5
14-viii-'60	100	8.3	75.5	95.5
18-viii-'60	100	8.3	74.1	91.0
22-viii-'60	100	8.0	77.0	86.2
26-viii-'60	100	6.8	75.0	87.7
30-viii-'60	100	4.4	77.7	80.2
3-ix-'60	84	3.3	78.8	83.3
7-ix-'60	68	3.0	79.0	80.3
11-ix-'60	68	2.0	78.1	86.7
15-ix-'60	50	1.5	78.3	80.3
19-ix-'60	50	1.0	81.1	81.0
23-ix-'60	50	1.0	82.5	80.5
27-ix-'60	50	1.0	79.2	81.0
1-x-'60	33	0.5	75.6	82.0
5-x-'60	16	0.3	77.2	79.0
9-x-'60	16	0.3	79.6	82.1
13-x-'60	16	0.2	79.0	66.2
17-x-'60	16	0.1	78.0	59.2
21-x-'60	16	0.1	72.8	58.2
25-x-'60	0	0.0	71.7	60.6
29-x-'60	0	0.0	68.2	59.0

The data presented in Table 5 show that from mid-July to end of August, when average relative humidity was high (above 85% for most of the time) and temperature was moderately high (in the neighbourhood of 75°F), 100% plants were infested. The incidence of the pest was at its peak with 6.5 to 8.6 average number of beetles per plant from 2nd August to 26th August when the average relative humidity was very high (from 86.2 to 95.5%) and temperature averaged from 73.6 to 77.0°F. The incidence declined fast during September when there

was relatively lower relative humidity averaging about 80% associated with relatively higher average temperature (78.1 to 82.5°F). During October, the incidence continued to decline further, becoming nil in the last week; this seems to be more due to the adverse effect of low relative humidity which fell to about 60% than to low temperature. Chowdhary (1962) also recorded it feeding in large numbers after rain in July in Tripura.

Seasonal history and number of generations: The pest was active from mid-July to October, being most active during August. Breeding period was found to be confined only from July to about 3rd week of September. Therefore, taking the length of life cycle from egg to adult as 22 to 25 days, the pest seems to have 3 overlapping generations in a year. As the female beetles stopped oviposition and contained only immature ovaries during October after which they were not seen, it can be taken as a circumstantial evidence that hibernation occurs as adult beetles in soil. Hibernation as adult beetles has been recorded to take place, either singly or in batches, on the underside of leaves or among clods of earth in *P. fuscicornis* L. and *P. malvae* Illig. which pass through 1 to 2 generations in a year in Rumania (Manolache, Dobreanu and Manolache 1938, 1943).

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